KIMS Q&A

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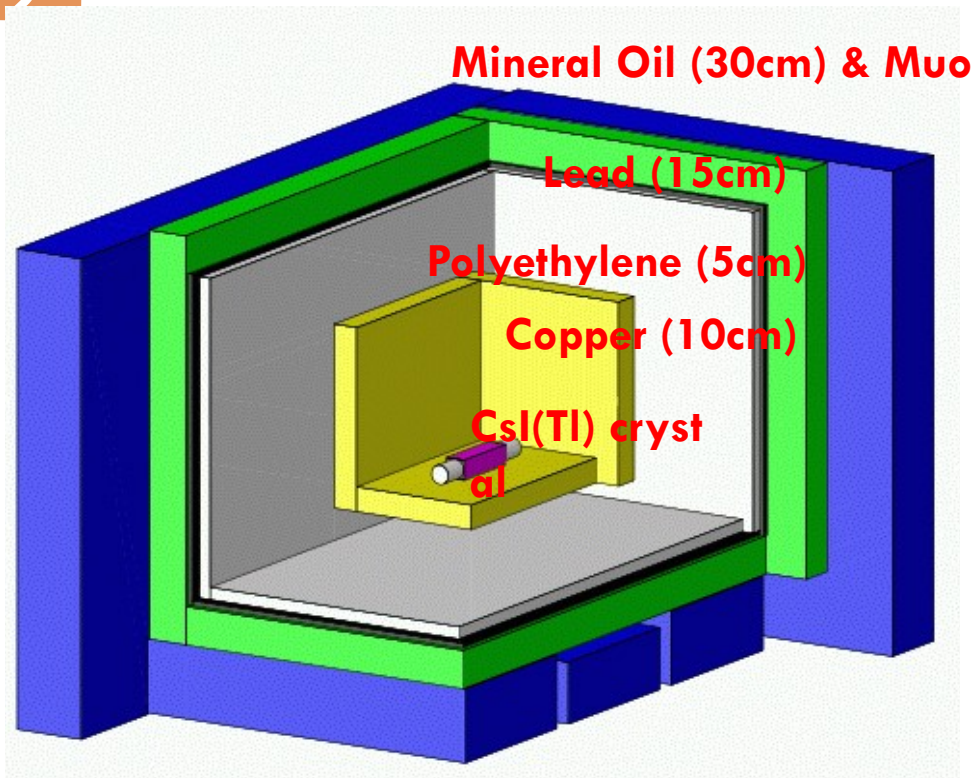
SLAC

Experimental Status and Target Mass



CsI(Tl) Crystal 8x8x30 cm^3
(8.7 kg) + 3" PMT (9269QA)

- 2005. 12 – 2006. 3 4 crystals ran → limits
- 2009. 9 – 2012. 10. 12 crystals (total 104.4kg) → limits, modulations
- 2012. 10 – 2013. 12 12 crystals in test mode. → PMT upgrades.
- 2014. 1. - upgrade run, KIMS-NaI, AMoRE-DARK

Backgrounds after passive and active Shielding

Type	Source	Level (events/keV/kg/day)	activity
muon	neutron	<0.01	
external	PMT-U	0.2-0.4	0.32(0.09) Bq
	PMT-Th	0.1-0.25	0.16(0.03) Bq
	PMT-K	0.15-0.25	0.35(0.07) Bq
internal	^{137}Cs	0.3-0.5	1.40(0.80) mBq/kg
	^{134}Cs	0.2-0.4	8.10(1.67) mBq/kg
	^{87}Rb	~0.3	
	Surface Alpha	0.05-0.23	
	U,Th	<0.01	
Total		2.0-2.5	

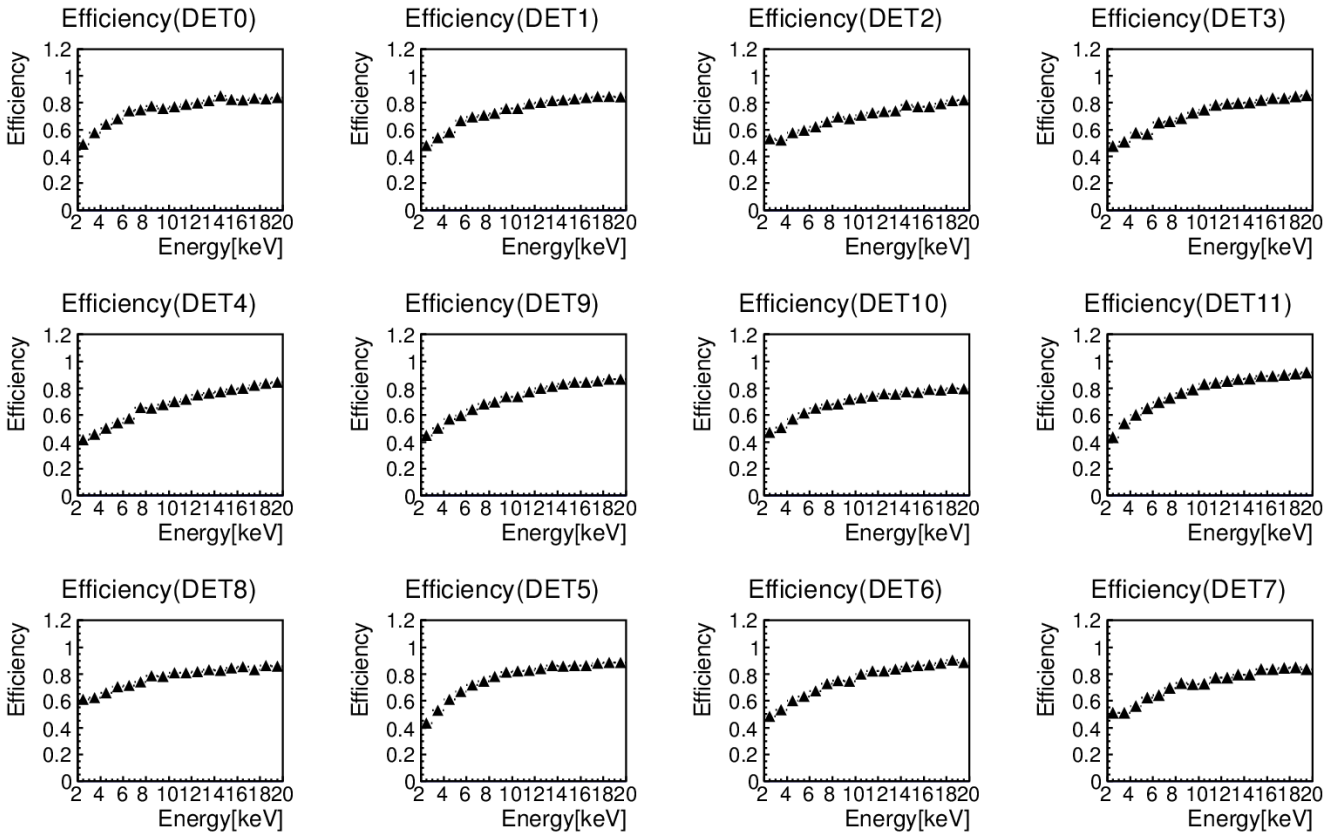
Detector Discrimination

- In KIMS, the discrimination power is by statistical analysis, rather t han event by event basis.
- Discrimination power is calculated as ;
  the 90% confidence background level / total background level.

events	Level	Discrimination Power
Nuclear recoil	0.01-0.02	100-200
Surface alpha	0.05-0.23	9-40

Energy Threshold

- **Trigger threshold ~ 1 keV**
- **Analysis threshold : 2 keV**
- **Nuclear recoil Acceptance @ 2 keV (threshold) ~ 0.4**



Multiple hit events are analyzed with cuts applied to calc ulate cut efficiency.

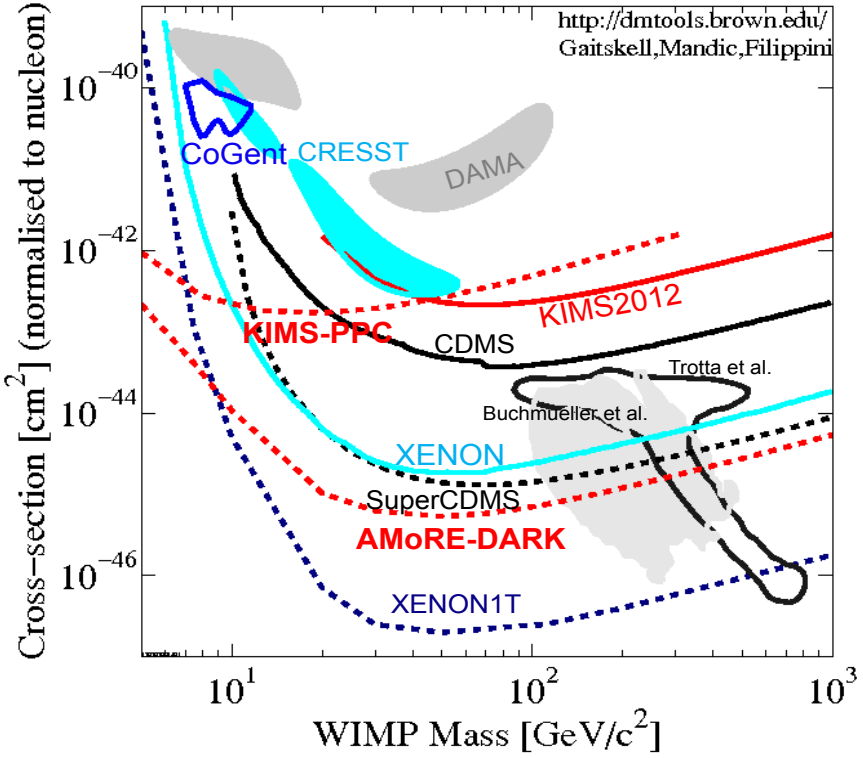
Sensitivity versus WIMP mass

KIMS current(2013.3) sensitivities

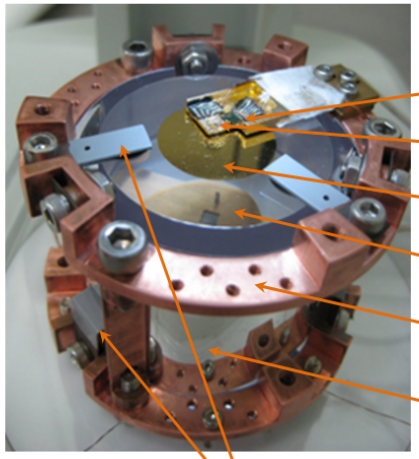
Wimp Mass	5	10	100	1000	10000
Current SI	3.0e-39	1.35e-40	2.32e-43	1.56e-42	1.51e-41
Current SD			1.65e-38	7.94e-38	7.46e-37

AMoRE-DARK

- $^{nat}Ca^{nat}MoO_4$ scintillating crystals
- in bolometer mode.
- ~ 200 kg year data.
- High sensitivity in low mass WIMP.
- $<10^{-5}$ dru background
- Expect 10^{-43} cm^2 @ 5GeV WIMP mass.



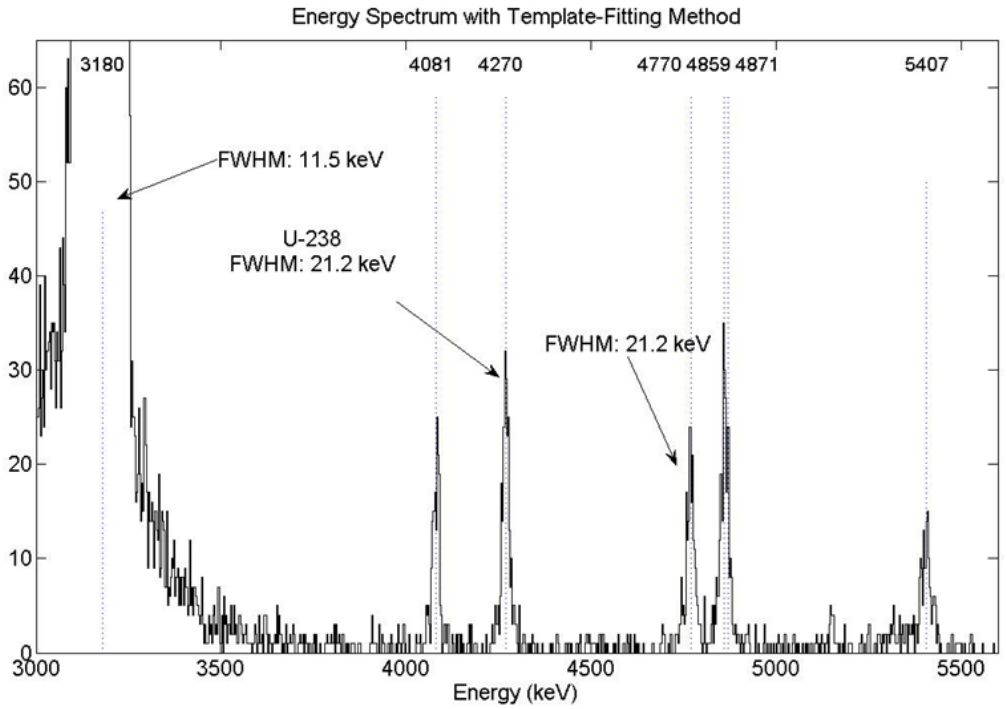
Bolometer R&D



Scintillating bolometer with multiple target MMC sensor.

DE ~ 10 keV at present

Goal = 5 keV

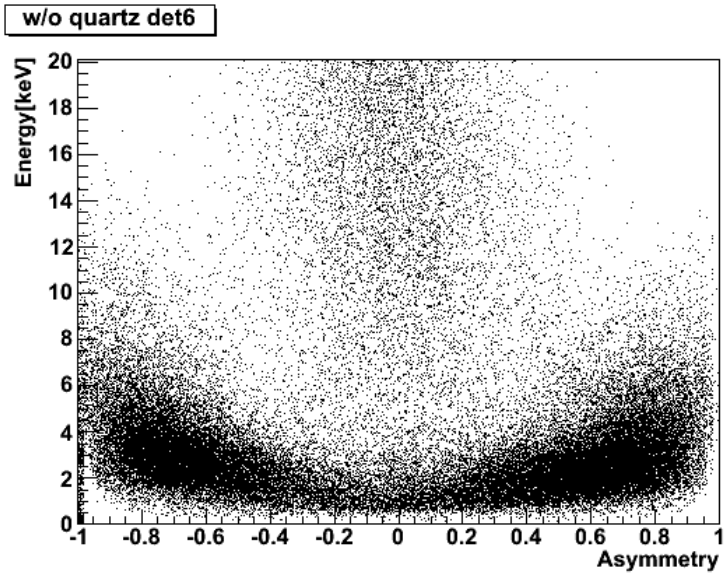


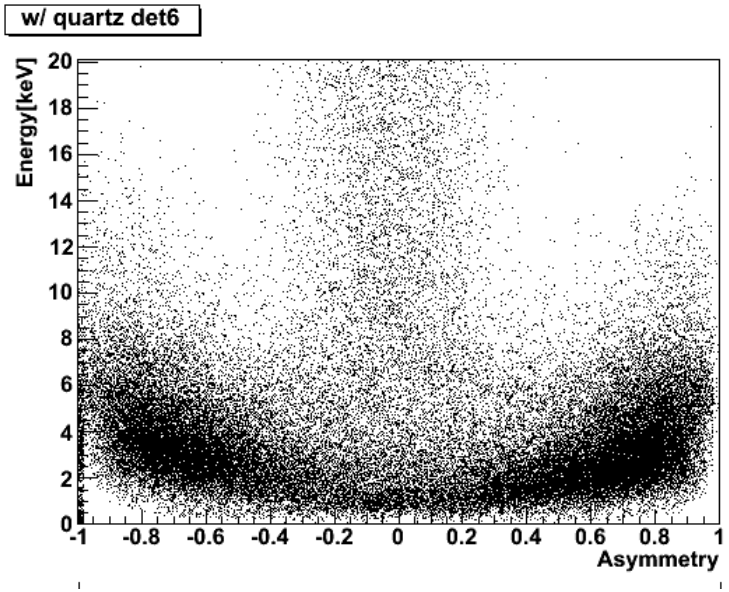
Experimental Challenges.

- There are abundant low energy events in current CsI(Tl) crystals which are certa inly not due to physical radiation. At present these events are reduced by variou s cuts developed and efficiencies for these cuts are evaluated multiple Compton hit events.
- We have to understand the origin of these events.
- At present, various new PMTs are tested at underground coupled CsI(Tl) crystal s.

New PMT test : R6956MOD SEL PMT + CsI(Tl)

Still we have ~ 3 keV noise.

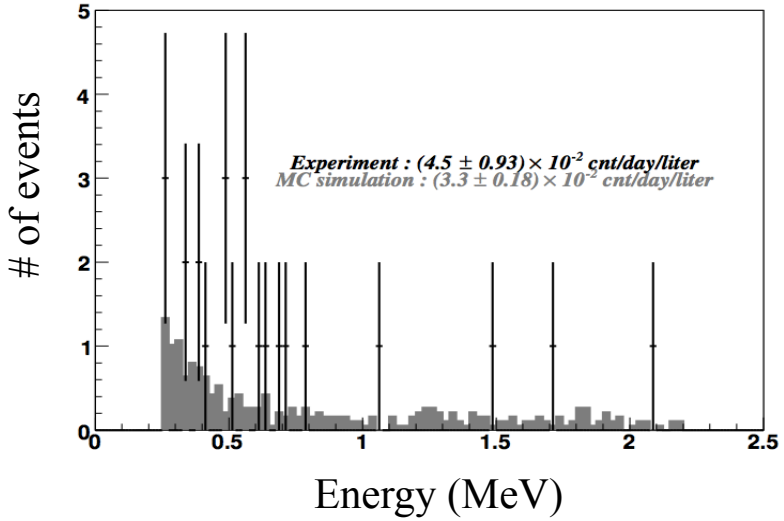




Experimental Challenges.

- We estimated that current Y2L depth(700m) is still deep enough for next plan fo r NaI(Tl) crystal experiment and bolometer upgrade.

Measured & simulated neutron energy spectra



Muon induced neutrons at CsI position.

- Data :

  $(4.5\pm0.93)\times10^{-2}$ counts/(liter-days)

- G4 simulation w/ muons

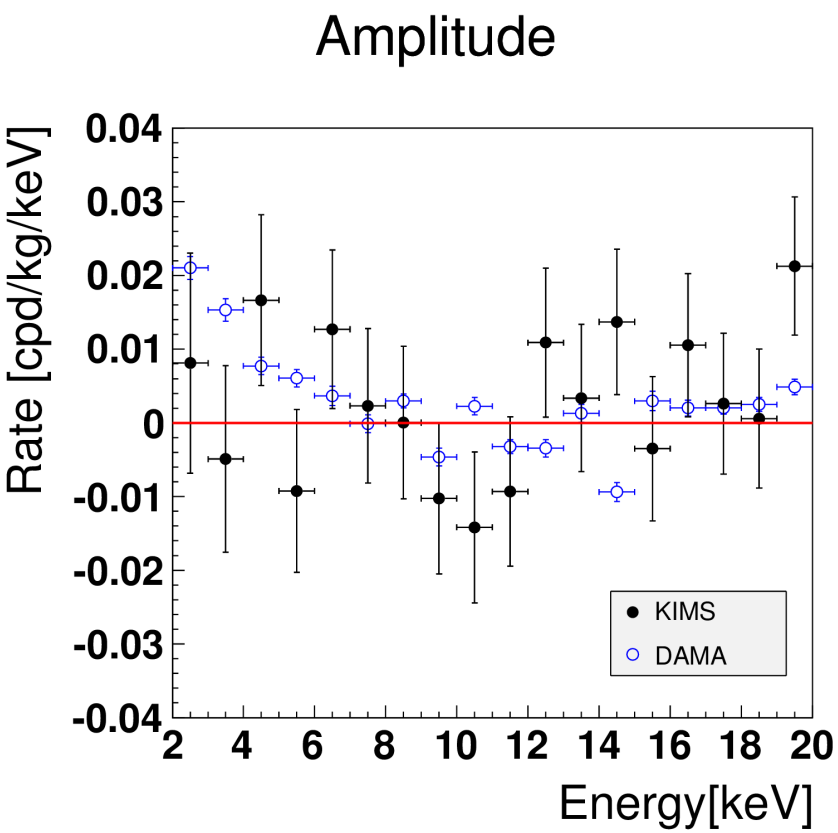
  $(3.3\pm0.18)\times10^{-2}$ counts/(liter-days)

→ < 0.003 dru @ 2 keV

→ ~ 10^{-5} dru with bolometer & muon veto

Annual Modulation

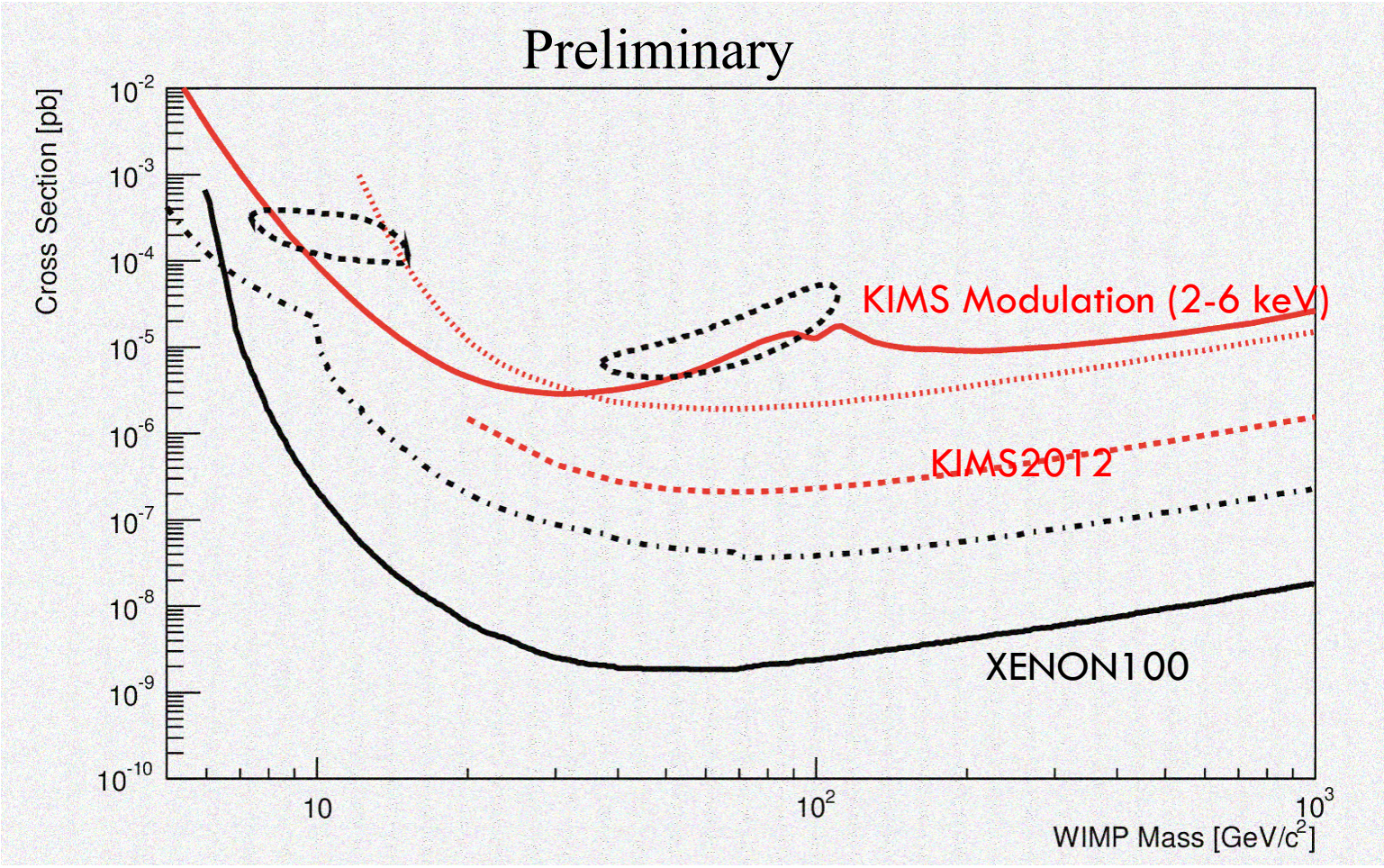
- **2.5 year data(75530 kg days) analyzed for annual modulation signal.**
- **The threshold of nuclear recoil energy > 10 keVnr**



DAMA		KIMS	
Energy	Amplitude	Energy	Limit (90% CL)
2-4 keV	0.0170±0.0024	3-6 keV	< 0.0119 (2.6 σ)
2-5 keV	0.0129±0.0018	3-7 keV	< 0.0136
2-6 keV	0.0097±0.0015	3-8 keV	< 0.0120

Stability of the Experiment

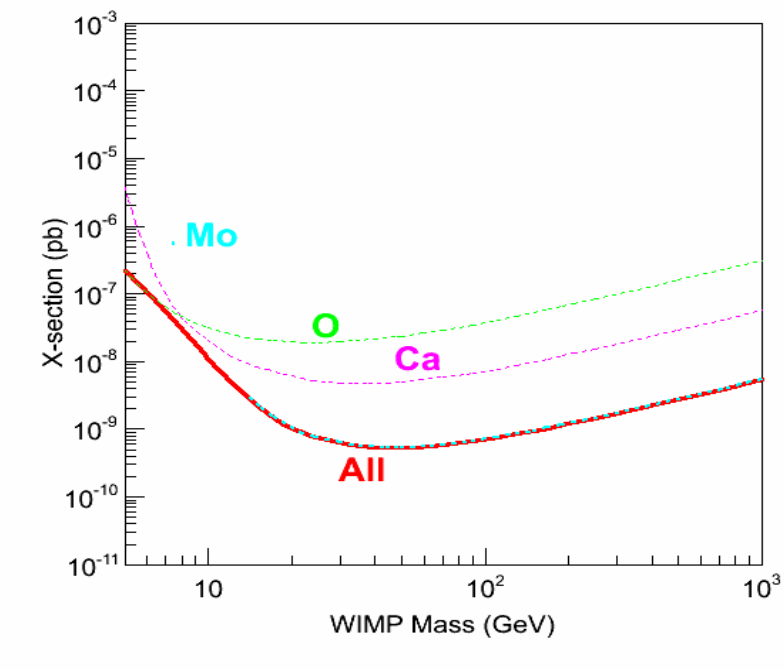
item	Amplitude (events/keV/kg/day)
PMT gain	<0.0015
Temperature modulation	< 10^{-4}


Preliminary
Cross Section [pb]
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10
10^{2}
10^{3}
WIMP Mass [GeV/c^2]
KIMS Modulation (2-6 keV)
KIMS2012
XENON100

9) **Unique Capabilities**

- Do you have unique capabilities to identify whether a signal is due to WIMPs, asid e from the standard event by event discrimination and multiple scattering? → No
- Does your technology allow different targets in the same experiment? If so, what c hanges are required to make use of these? → with CaMoO4 bolometer, we have Ca , O, and Mo targets.
- Does your experiment have sensitivity to dark matter interactions other than spin- i ndependent or spin-dependent? → No

10) **Determining WIMP properties and astrophysical parameters**



Multiple target scintillating bol ometer is interesting for low m ass WIMP and also mass decisi on for WIMPs.